

Size-Resolved Trace Elemental and Organic Aerosols at Mauna Loa Observatory, Spring 2000

THOMAS A. CAHILL, STEVEN S. CLIFF, MICHAEL JIMENEZ-CRUZ,
SARAH G. RIDDLE, PETER B. KELLY, AND KEVIN D. PERRY
DELTA Group, University of California, Davis 95616

The size distribution of aerosols is of key importance in their climatic impact. To better establish this parameter, and in anticipation of the large Aerosol Characterization Experiment (ACE)-Asia project of spring 2001, our new 8-stage slotted Davis Rotating-drum Unit for Monitoring (DRUM) sampler was deployed at Mauna Loa Observatory (MLO) to collect aerosols during the Asian transport period each spring. While we had earlier worked with data from simple fine filters ($< 2.5\text{-}\mu\text{m}$ diameter, 1989-present) and a 3-stage sampler (spring 1996), the present sampler was designed to map the optically important region below $1\text{ }\mu\text{m}$ with five submicron size classifications: 1.15 to 0.75, 0.75 to 0.56, 0.56 to 0.34, 0.34 to 0.23, and 0.23 to $0.07\text{ }\mu\text{m}$

aerodynamic diameter. Regrettably, the samples were integrated over 6 weeks because of a failure of the drum rotation system, a problem that was corrected for the studies at MLO in spring and summer 2001. The samples were scanned for elemental content, sodium through uranium, by the new synchrotron-x-ray fluorescence (S-XRF) aerosol and climate microprobe at the Advanced Light Source, Lawrence Berkeley National Laboratory, and for organic matter with the Laser Desorption/Ionization Time-of-Flight Mass Spectrometer (LDI TOFMS) at Davis.

The data for aerosol elements in Figure 1 show that chlorine (and sodium, not shown) as a tracer of sea salt aerosols is essentially absent below $1\text{ }\mu\text{m}$, while iron (a

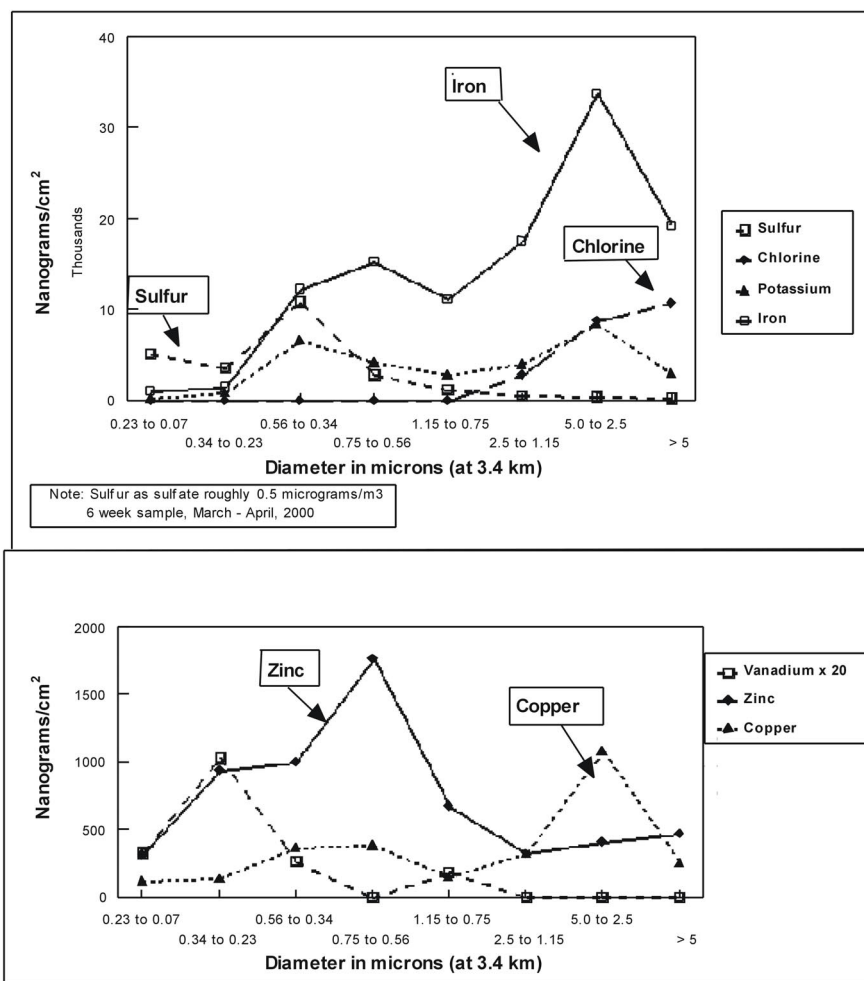


Fig. 1. Six-week composite sample of size-resolved aerosols measured at Mauna Loa Observatory, March-April 2000.

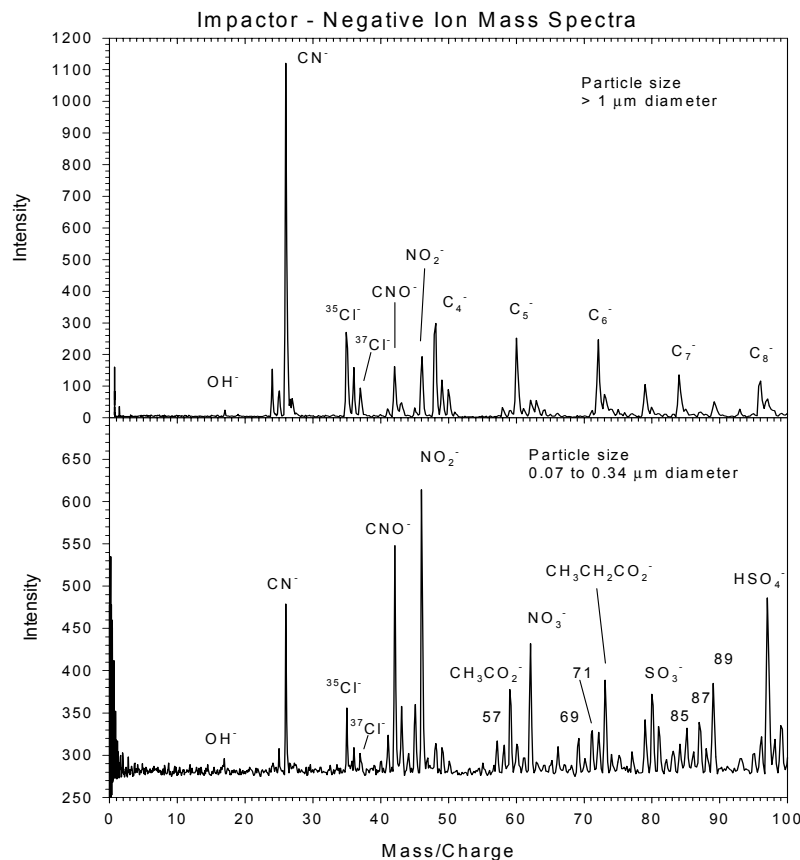


Fig. 2. Sample mass spectra of organic matter at Mauna Loa Observatory, March-April 2000.

soil tracer) has two separate peaks, one submicron ($0.66 \pm 0.3 \mu\text{m}$) and one supermicron (approximately $4 \mu\text{m}$, with the uncertainty associated with the inlet capture). All the soil, which includes fine soil on upslope winds, appears consistent with Asian sources. Except for a small amount of sulfur associated with the sea salt, sulfur was fine, peaking at $0.45 \pm 0.3 \mu\text{m}$. The very fine/ultrafine sulfur is not the tail of the larger peak, but represents a third mode that we hypothesize is primarily industrial, based on recent data in the United States and Asia. This association is strengthened by the trace element data, which have a complex size profile indicative of diverse sources and processes and an important ultrafine component. The resolution of these hypotheses must await the availability of time-resolved data.

The samples were also analyzed by LDI TOFMS for organic speciation. Some of the results are shown in Figure

2 and exhibit dramatic differences as a function of size. The HSO_4^- peak is not seen in the supermicron fraction, but is prominent in the ultrafine aerosols. Normally, this is associated with a sulfuric acid aerosol. Again, much work needs to be done to understand these complex results.

In summary, a great deal was learned during these tests, both about sampling and analysis in the very clean conditions at MLO and in the complex suite of compositional techniques that can now be employed on such samples. The soils are even finer than estimated in our earlier work, and thus more important per unit mass in terms of optical impact. The organics possess complicated patterns in size and bear little resemblance to existing source profiles such as biomass burning, and diesel and automotive smoke.

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